REMARKS / ARGUMENTS

Reconsideration of the above identified application in view of this Amendment is respectfully requested. This Amendment is in response to the Office Action dated July 18, 2001. By said Office Action, the drawings were objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "80" has been used to designate both reflector and surface, whereby the Examiner requested correction. Claims 1 - 3, 5, 6, and, 27, were rejected under 35 U.S.C. 102(e) as being anticipated by Seefeldt et al. (U.S. Patent No. 6,021,675). Claims 4, 14 - 16, and, 28, were not considered for examination by the Examiner since the Examiner stated it would have required a new search in a different class.

By this Amendment, the Applicant has corrected the 'obvious-to-correct' grammatical error appearing in the specification, relating to the word "porosive". The Applicant has corrected the 'obvious-to-correct' drawing error appearing in Fig. 5, relating to the position of one of the three electrodes 66 specified as being attached to first element 62 of piezoelectric device 60. The Applicant has corrected the 'obvious-to-correct' editorial error appearing in the specification, relating to reference character "80" illustrated in Fig. 7 of the drawings. Formal drawings will be submitted at the time of paying the issue fee. Independent claim 1, and, claim 2 depending therefrom, have been amended. Claims 4 - 28 have been cancelled. New independent claim 29, and claims 30 - 31 depending therefrom, have been added.

Briefly, the present invention relates to a piezoelectric device featuring a first element of porous crystalline material, a second element being attached to, or integrally formed with, the first element, and at least one electrode being in electrical contact solely with the first element of the first and second elements, such that subjecting the first element to an electric potential via the at least one electrode results in a strain induced by the first element on the

second element. A corresponding method of piezoelectrically inducing strain in an element, features the steps of attaching to the element, or integrally forming with the element, an additional element of porous crystalline material being in electrical contact solely with at least one electrode, such that subjecting the additional element to an electric potential via the at least one electrode results in a strain induced by the additional element on the element.

'Obvious-to-correct' Corrections

By this Amendment, the Applicant has corrected the 'obvious-to-correct' grammatical error appearing in the specification, on p. 38, line 18, whereby the grammatically incorrect originally written word "porosive" is to be replaced with the grammatically correct word "porous". Correction of this 'obvious-to-correct' error is respectfully requested.

By this Amendment, the Applicant has corrected the 'obvious-to-correct' drawing error appearing in Fig. 5, relating to the position of one of the three electrodes 66 specified as being attached to first element 62 of piezoelectric device 60. In Fig. 5, the Applicant requests to please horizontally move the one electrode 66 drawn as the solid box attached to second element 64 of piezoelectric device 60, to the right, as the same one electrode 66 drawn as the same solid box, but, attached to the viewable side of first element 62 of piezoelectric device 60, as clearly indicated by the 'red' correction markings made on the herein enclosed copy of Fig. 5 as originally filed.

Support for this amendment is clearly found in the specification as originally filed. Specifically, with reference to Figure 5, on p. 34, lines 8 - 18, it is stated "Device 60 further includes at least one electrode 66 (three are shown) which is in electrical contact with first element 62". Therein, it is further stated "The arrangement of the above components is selected such that subjecting first element 62 to an electric potential via electrode(s) 66 results in a strain induced by first element 62 on second element 64. A method of producing a

piezoelectric device (that is, piezoelectric device **60** illustrated in Figure 5) according to the present invention is effected by attaching to, or integrally forming with, a first element (**62**) of porous crystalline material, a second element (**64**), and attaching to the first element (**62**) at least one electrode (**66**), such that subjecting the first element (**62**) to an electric potential via the electrode(s) (**66**) results in a strain induced by the first element (**62**) on the second element (**64**)".

In view of these statements in the specification as originally filed, by examining originally drawn Figure 5, it is clearly obvious that the one electrode **66** drawn as the solid box attached to second element **64** of piezoelectric device **60**, is 'incorrectly' drawn, and is 'correctly' drawn as the solid box attached to first element **62** of piezoelectric device **60**, as clearly indicated by the 'red' correction markings made on the herein enclosed copy of Fig. 5 as originally filed, and such correction is respectfully requested.

Objection

The Examiner objected to the drawings as failing to comply with 37 CFR 1.84(p)(4) because reference character "80" has been used to designate both "reflector" and "surface", whereby the Examiner requested correction.

By this Amendment, the Applicant has corrected the 'obvious-to-correct' editorial error appearing in the specification, on p. 36, line 5, relating to reference character "80" illustrated in Fig. 7 of the drawings. As indicated above, the Applicant requests replacing the paragraph beginning at p. 36, line 1, including the phrase "Surface **80** may be formed as a reflective" in line 5, with the above indicated correctly rewritten paragraph, including the phrase "Surface **86** may be formed as a reflective", wherein this particular phrase the 'obviously incorrect' reference number "**80**" has been replaced by the ' obviously correct' reference number "**86**".

Support for this 'obvious-to-correct' amendment is clearly found in the specification, in the 'remaining' text on p. 36 and in the corresponding Figure 7 of the application as originally filed. Therein, it is clearly written and illustrated, with the intention for it to be fully understood, that reference number "80" uniquely refers to the "reflector", while reference number "86" uniquely refers to the "reflective surface", also referred to as the "surface".

35 U.S.C. 102(e) Rejection

The Examiner rejected claims 1 - 3, 5, 6, and, 27, under 35 U.S.C. 102(e) as being anticipated by Seefeldt et al. (U.S. Patent No. 6,021,675). The Examiner's rejection is respectfully traversed.

The Examiner stated that "Seefeldt discloses a piezoelectric device comprising a first silicon porous material 138, a second element made of crystal 62 attached to first element, and at least one electrode 114 being in electrical contact with first element (see figure 25), such that subjecting first element to an electric potential results in strain induced by first element on second element (column 4, lines 54-58 and column 5, lines 53, 62, 63 and column 6, lines 3-7)."

The Applicant of the present invention strongly contends that the Examiner is clearly incorrect, in several ways, by using the Seefeldt disclosure for 'attempting' to describe 'anticipation' of the piezoelectric device as recited by original claim 1, clearly described on at least p. 34 and illustrated in Fig. 5, in the specification of the originally filed application.

With respect to device 'structure', in Fig. 25 of the Seefeldt disclosure, there is clearly illustrated a side view of a structure having at least one electrode 114 in electrical contact with a porous silicon p-type layer 138 (first element) and simultaneously in electrical contact with a plate or beam 62 (second element) of an epitaxial n-type layer 60. Moreover, Fig. 8 of the Seefeldt disclosure clearly illustrates a top-down view of a related structure having electrode

114 in electrical contact with plate or beam 62 (second element) of epitaxial n-type layer 60. Thus, the Examiner's structure cited in the Seefeldt disclosure clearly has the at least one electrode in electrical contact **both** with a porous crystalline material first element **and** with a plate or beam second element.

By strong contrast, in the structure of the piezoelectric device (60) of the present invention, as recited by original claim 1, clearly described on p. 34 and illustrated in Fig. 5, in the specification of the originally filed application, there is a "first element (62) of porous crystalline material, a second element (64) being attached to, or integrally formed with, said first element (62), and at least one electrode (66) being in electrical contact with said first element (62)". Accordingly, in the present invention, the at least one electrode is in electrical contact **solely** with a first element of porous crystalline material, and is not at all in electrical contact with a (non-porous) second element, or with any other (non-porous) element.

Therefore, the structure illustrated in Fig. 25, or the related structure illustrated in Fig. 8, or any other related structure illustrated in the Seefeldt disclosure, clearly does not correspond to, and therefore, clearly does not anticipate, the structure of the piezoelectric device (60) of the present invention, as recited by original claim 1, clearly described on p. 34 and illustrated in Fig. 5, in the specification of the originally filed application, comprising "a first element (62) of porous crystalline material, a second element (64) being attached to, or integrally formed with, said first element (62), and at least one electrode (66) being in electrical contact with said first element (62)".

With respect to device 'function', as a direct consequence of the structure illustrated in Fig. 25 of the Seefeldt disclosure having at least one electrode 114 in electrical contact with porous silicon p-type layer 138 (first element) and simultaneously in electrical contact with plate or beam 62 (second element) of epitaxial n-type layer 60, where, in particular, electrode 114 is in electrical contact with plate or beam 62 (second element) as clearly illustrated in Fig.

8, or as illustrated in any other related figure of the Seefeldt disclosure, the function of any such structure illustrated in the Seefeldt disclosure clearly does not correspond to, and therefore, clearly does not anticipate, the function of the piezoelectric device (60) of the present invention, as recited by original claim 1, clearly described on p. 34 with reference to Fig. 5, in the specification of the originally filed application, "such that subjecting said first element (62) of porous crystalline material to an electric potential via said at least one electrode (66) results in a strain induced by said first element (62) on said second element (64)".

Support for this Applicant's contention with respect to device function is clearly found in the specification as originally filed, and in prior art teachings of crystalline silicon micromachining technology and piezoelectric phenomena. Specifically, on p. 37, lines 7 - 14, it is stated "The structure of the porous crystalline material (that is, the first element) is important to its piezoelectric/piezooptic response. In low-porosity materials, the residual matter is not made of separate islands, and thus its conduction is high and the application of voltage to it results in short-circuiting between the electrodes (percolation). When the pores capture a larger fraction of the porous matter, it is possible to have an applied voltage. The percentage porosity of the percolation limit is different with different raw silicon stoichometry, orientation, processing procedure and processing chemicals". These statements are based on theory, principles, and, applications, of crystalline silicon micromachining technology and piezoelectric phenomena as taught about in the prior art, for example, as referenced on p. 33, in particular, and, throughout the Field and Background section, in the specification of the present invention.

Accordingly, operating the Seefeldt invention by applying an electric potential via the at least one electrode 114 in the structure illustrated in Fig. 25, or the related structure illustrated in Fig. 8, or any other related structure illustrated in the Seefeldt disclosure,

whereby the at least one electrode 114 is also in electrical contact with plate or beam 62 (second element) of epitaxial n-type layer 60, results in a short-circuit or electrical conduction between the at least one electrode 114. In strong contrast, implementing the present invention by "subjecting said first element (62) of porous crystalline material to an electric potential via said at least one electrode (66)" in piezoelectric device 60, "results in a strain induced by said first element (62) on said second element (64)", as recited by original claim 1, clearly described on p. 34 with reference to Fig. 5, in the specification of the originally filed application, which is clearly not anticipated by, or, obviously derived from, the disclosure of Seefeldt.

Furthermore, with respect to device structure/function, in the disclosure of Seefeldt, in column 4, lines 54 - 58, as cited by the Examiner, it is stated ". . . end portions 70 allows strain in the epitaxial layer 60 (or in the substrate 14) in the direction of the longitudinal axis 66 of the beam 62 to change the resonant frequency of the beam 62. In the specific embodiment illustrated, the beam 62 is part of the epitaxial layer 60 . . . "; in column 5, lines 62 - 63, as cited by the Examiner, it is stated "The transducer 10 includes means for measuring resonating motion of the beam 62"; and, in column 6, lines 3 - 7, as cited by the Examiner, it is stated "The resistance of the piezoresistor 122 changes with strain in the beam 62 in accordance with the piezoresistive effect, and thus permits resonance of the beam 62 to be measured in a known manner". The Applicant strongly contends that each of these citations relates to describing operation of the force transducer 10 of the Seefeldt invention **following physicochemical removal of the porous silicon layer.** Equally stated, the cited Seefeldt invention **involves porous silicon 'exclusively' during intermediate processing steps used 'only' for producing intermediate precursor structures of the force transducer 10, whereby, the produced force transducer 10 device clearly has no porous silicon in its**

structure, and therefore, there is no role or function of porous silicon in its operation of inducing strain for causing change in the resonant frequency of the beam 62.

Support for this contention by the Applicant is clearly found throughout the entire Seefeldt disclosure, especially with reference to description relating to formation of the transducer **10**, as indicated in column 6, lines 25 - 46. Therein, it is stated "5. forming porous silicon of the p-type layer **138** and the p-type sinkers **142** by anodization; 6. oxidizing the porous silicon to form silicon dioxide in three pre-cavity regions;". Additionally, in column 8, lines 31 - 33, it is stated "The p-type layer **138** and the p-type sinkers **142** are anodized to form a pre-cavity region consisting of porous silicon"; in column 8, lines 47 - 51, it is stated "The porous silicon thus defines a pre-cavity region in the area previously occupied by the p-type layer **138** and p-type sinkers **142**. The porous silicon in the pre-cavity region is oxidized to form silicon dioxide"; in column 8, lines 60 - 64, it is stated "Upon oxidation, the porous silicon in the pre-cavity region is converted to silicon dioxide, and a layer of silicon dioxide having a thickness of about 1500 angstroms is incidentally formed over the entire upper surface of the n-type epitaxial layer **60**; and, in column 9, lines 55 - 57, it is stated "The porous silicon dioxide in the pre-cavity regions is removed or dissolved by etching to form the cavities **22, 46** and **50**".

Indeed porous silicon is formed in many micromachining processes as a sacrificial layer of precursor structures of electronic devices, ordinarily used to produce an empty volume in a later step, such as the previously cited pre-cavity regions in the intermediate precursor structures of the force transducer described in the Seefeldt disclosure, as well as intermediate precursor structures described in the other prior art cited by the Examiner, for example, in Iwata et al. (U.S. Patent No. 5,665,250), Yagi et al. (U.S. Patent No. 6,143,190), and, Seefeldt et al. (U.S. Patent No. 5,834,333), and, taught about in the Applicant's cited

prior art, for example, as referenced on p. 33, in particular, and, throughout the Field and Background section, in the specification of the present invention.

While continuing to traverse the Examiner's 102(e) rejection, the Applicant has, in order to expedite the prosecution, chosen to amend independent claim 1 in order to clarify and emphasize the important distinction relating to the electrical configuration and operation, between the piezoelectric device of the present invention and the force transducer device of the Seefeldt et al. patent cited by the Examiner, and, in order to clearly show that the present invention is not anticipated by, or obviously derived from, that disclosed in the Seefeldt et al. patent and from the other particular prior art cited by the Examiner, and from other prior art in general, either singly or in combination.

Specifically, claim 1 has been amended to clarify and emphasize that the claimed piezoelectric device of the present invention features "the at least one electrode being in electrical contact solely with said first element of said first and second elements,", as recited by amended claim 1.

Support for this amendment is clearly found in several relevant places throughout the specification as originally filed. Specifically, with reference to Figure 5, on p. 34, lines 8 - 18, it is stated "Device **60** further includes at least one electrode **66** (three are shown) which is in electrical contact with first element **62**". Therein, it is further stated "The arrangement of the above components is selected such that subjecting first element **62** to an electric potential via electrode(s) **66** results in a strain induced by first element **62** on second element **64**. A method of producing a piezoelectric device (that is, piezoelectric device **60** illustrated in Figure 5) according to the present invention is effected by attaching to, or integrally forming with, a first element (**62**) of porous crystalline material, a second element (**64**), and attaching to the first element (**62**) at least one electrode (**66**), such that subjecting the first element (**62**) to an

electric potential via the electrode(s) (66) results in a strain induced by the first element (62) on the second element (64)".

Additional support for this amendment is clearly found in the specification, with reference to Figure 7, on p. 36, lines 3 - 5, wherein it is stated "Reflector **80** includes a first layer **82** of porous crystalline material which is attached to, or integrally formed with, a second layer **84**", and on page 37, lines 2 - 4, wherein it is stated "reflector **80** further includes at least one electrode **88**, through which an electric potential is applicable to first layer **82**".

Additional support for this amendment is clearly found in the specification, with reference to Example 1, on p. 38, line 12 to p. 39, line 16, wherein, on p. 39, lines 8 - 9, it is stated "Electrodes were then made on the porous silicon".

Additional support for this amendment is clearly found in the specification, with reference to Example 3, wherein, on p. 44, lines 10 - 13, it is stated "The piezoelectric and electrorestrictive response of the porous silicon can be attributed to a number of processes, the foremost of which is electrostatics pull between the porous crystalline material under the electrodes".

Accordingly, throughout the specification of the present invention, including the figures, Examples, and, recitation of claim 1, there is no explicit or implicit statement or suggestion that the at least one electrode of the claimed piezoelectric device is in electrical contact with any element other than the element of porous crystalline material.

In view of the Applicant's previously stated remarks, above, contrasting device 'structure' and device 'function' of the Seefeldt invention to the present invention, with respect to the type of electrical contact between "the at least one electrode" and the first and second elements, the Applicant asserts that the piezoelectric device recited by amended claim 1 is clearly distinct and not anticipated by, or obviously derived from, the Seefeldt et al. disclosure of the force transducer, and, from the other particular prior art cited by the Examiner, and

from other prior art in general, either singly or in combination. Thus, the Applicant believes that the amendment of claim 1 completely overcomes the Examiner's rejection based on grounds of 35 U.S.C. 102(e), and is therefore in allowable condition and such action is respectfully requested.

By this amendment, original claim 2 has been amended according to the proper grammatical format of a Markush group type claim. Specifically, the word "or" in original claim 2 has been replaced by the word "and", and, a comma has been added following the words "other material". In view of the preceding discussion regarding the allowable condition of amended claim 1, the Applicant submits that claim 2 depending therefrom, is now in allowable condition and such action is respectfully requested.

By this amendment, claims 4 - 28 have been cancelled.

New Claims

New independent claim 29, and claims 30 - 31, depending therefrom, reading upon a corresponding 'method' of the present invention, that is, a method of piezoelectrically inducing strain in an element, have been added to be totally consistent with, and complementary to, amended claim 1, and, claims 2 - 3, depending therefrom, reading upon the piezoelectric 'device' of the present invention.

Support for the addition of new claims 29 - 31 is clearly found in the Specification of the originally filed application. Specifically, with reference to Figure 5, on page 34, lines 3 - 18, wherein it is stated "Device 60 includes a first element 62. Element 62 is of porous crystalline material, such as, but not limited to, porous silicon. Device 60 further includes a second element 64 which is attached to, or integrally formed with, first element 62. Device 60 further includes at least one electrode 66 (three are shown) which is in electrical contact with first element 62. The arrangement of the above components is selected such that subjecting

first element 62 to an electric potential via electrode(s) 66 results in a strain induced by first element 62 on second element 64". These statements in the originally filed disclosure clearly represent subject matter for recitations of new method claims 29 - 31, reading upon a corresponding 'method' of piezoelectrically inducing strain in an element, totally consistent with, and complementary to, amended claim 1, and, claims 2 - 3, depending therefrom, reading upon the piezoelectric 'device' of the present invention.

Examination of new claims 29 - 31 on the merits of the claimed invention is respectfully and earnestly solicited.

Iwata et al. (U.S. Patent No. 5,665,250-A), Harada et al. (U.S. Patent No. 5,801,069-A), Yagi et al. (U.S. Patent No. 6,143,190-A), Seefeldt et al. (U.S. Patent No. 5,834,333-A), Ng et al. (U.S. Patent No. 5,199,298-A), Kurtz (U.S. Patent No. 5,405,786-A), Jaenker (U.S. Patent No. 6,043,587-A), and, Anderson et al. (U.S. Patent No. 6,168,948-B1), cited as being pertinent to the Applicant's disclosure in PTO-892 to establish the state of the art, have been carefully reviewed, but are deemed not to render the Applicant's invention unpatentable, either singly or in combination, as was properly determined by the Examiner in said Office Action.

By this Amendment, the Applicant respectfully submits that independent claim 1, and hence dependent claims 2 and 3 are now in condition for allowance. Examination of new claims 29 - 31 on the merits of the claimed invention is respectfully and earnestly solicited.

Attached hereto is a marked-up version of the changes made to the Specification, Drawings, and Claims, by the current Amendment. The attached pages are captioned "**VERSION WITH MARKINGS TO SHOW CHANGES MADE**".

The Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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Date: December 16, 2001

Encl.:

1. Two month extension fee form/payment.
2. VERSION WITH MARKINGS TO SHOW CHANGES MADE.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Text in bold brackets, [xxxx], means that the bracketed letter, word, phrase, or section, has been 'deleted' from the indicated original Specification / claim, and 'does not' appear in the indicated replacement (amended) Specification / claim. Underlined text, xxxx, means that the letter, word, phrase, or section, has been 'added' to the indicated original Specification / claim, and 'does' appear in the indicated replacement (amended) Specification / claim.

In the Specification:

The paragraph beginning at line 1 of page 36 has been amended as follows:

Figure 7 shows an adaptive reflector in accordance with the teachings of the present invention, which is referred to hereinbelow as reflector **80**. Reflector **80** includes a first layer **82** of porous crystalline material which is attached to, or integrally formed with, a second layer **84** having a reflective surface **86**. Surface **[80]** **86** may be formed as a reflective coat over first layer **82**, or alternatively or additionally, layer **82** may be polished so as to serve as a reflecting surface.

The paragraph beginning at line 14 of page 38 has been amended as follows:

The mirror was constructed of a silicon wafer, polished on both sides, whose front (mirror) side was evaporated with a reflective layer and the wafer was annealed at 450 °C for approximately 30 minutes. 1" or 2" n-type wafers were used, with a diameter of the porous area of 0.5" and 1". The back side of the wafer was made [porosive] porous by etching in HF:ethanol (1:1) solution, with the HF itself dissolved in water (1:1).

In the Drawings:

In Fig. 5, the one electrode 66 originally drawn as the solid box attached to second element 64 of piezoelectric device 60, has been horizontally moved to the right, as the same one electrode 66 drawn as the same solid box, but, attached to the viewable side of first element 62 of piezoelectric device 60, as clearly indicated by the 'red' correction markings made on the herein enclosed copy of Fig. 5 as originally filed.

In the Claims:

Claim 1 has been a mended as follows:

1. (Amended) A piezoelectric device comprising a first element of porous crystalline material, a second element being attached to, or integrally formed with, said first element, and at least one electrode being in electrical contact solely with said first element of said first and second elements, such that subjecting said first element to an electric potential via said at least one electrode results in a strain induced by said first element on said second element.

Claim 2 has been amended as follows:

2. (Amended) The piezoelectric device of claim 1, wherein said porous crystalline material is selected from the group consisting of porous silicon, [or] and, other material, with conductive channels and isolating channels such as spaces.

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Claims 4 - 28 have been cancelled.

New independent claim 29 has been added as follows:

29. (New) A method of piezoelectrically inducing strain in an element, the method comprising the steps of attaching to the element, or integrally forming with the element, an additional element of porous crystalline material being in electrical contact solely with at least one electrode, such that subjecting said additional element to an electric potential via said at least one electrode results in a strain induced by said additional element on the element.

New dependent claim 30 has been added as follows:

30. (New) The method of claim 29, wherein said porous crystalline material is selected from the group consisting of porous silicon, and, other material, with conductive channels and isolating channels such as spaces.

New dependent claim 31 has been added as follows:

31. (New) The method of claim 29, wherein the second element is made of crystal material.